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ABSTRACT

This document reports the view and recommendations expressed at the first meeting of the Ad Hoc Group on Scientific and Technical Information of the Organization for Economic Cooperation and Development (OECD). It is divided into five sections: (1) Introduction, which advocates that policy for processing and disseminating scientific and technical information be considered an inseparable part of policy for science and technology, (2) Current Information Policy and Practices, (3) Goals for a National Policy on Scientific and Technical Information, which include promoting the efficient and successful development of the nation's capability in science and technology, (4) Implications for Public Policy, which include international interdependence, and (5) Conclusions and Recommendations. Conclusions include: (1) The activities of the OECD in the scientific and technical information field have been constructive and should be expanded; (2) The rapid expansion of knowledge, especially in the fields of science and technology, makes it increasingly difficult to share and use information effectively, and governments at the highest level ought to accord priority attention to developing methods for the efficient use of new information; (3) Proper handling of scientific and technical information must not be regarded as an administrative or mechanical matter. It is recommended that policies and strategies for scientific and technical information be developed as an integral part of the design of policy as a whole and R and D policy in particular. (CK)

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INFORMATION for a changing society

Some policy considerations

AC002153

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT PARIS 1971

INFORMATION for a changing society

Some policy considerations

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT PARIS 1971

The Organisation for Economic Co-operation and Development (OECD) was set up under a Convention signed in Paris on 14th December, 1960, which provides that the OECD shall promote policies designed :

- *to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy ;*
- *to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development ;*
- *to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with international obligations.*

The Members of OECD are Australia, Austria, Belgium, Canada, Denmark, Finland, France, the Federal Republic of Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

PREFACE

Background and terms of reference

As one of the actions to implement the recommendations of the Third Ministerial Meeting on Science, the Secretary-General proposed the setting up of an Ad Hoc Group on Scientific and Technical Information with terms of reference to :

a) explore the nature, magnitude and implications of the needs for scientific and technical information and data in science, the economy and society, and how these needs may be met through changes in the structures, technologies and policies and management concepts in relation to information ;

b) present their conclusions and recommendations for the developing role of scientific and technical information and data systems and the policy and programme resources required for them to fill this role effectively in Member countries.

Mr. Pierre Piganiol, who in 1963 was Chairman of the Secretary-General's Ad Hoc Group responsible for the report " Science and the Policies of Governments ", accepted the Chairmanship of the Ad Hoc Group on Scientific and Technical Information.

It was emphasized that this Ad Hoc Group was being convened with the intention of setting the international and national activities in information into their broad context, and identifying the requirements for their effective and successful development. This would depend greatly on the continuation of the work of the OECD Information Policy Group, which had succeeded in developing and promoting the concepts of information policy and in exploring the possibilities of international systems and the economic considerations underlying their efficient use.

The Ad Hoc Group met for the first time early in 1969, and the final draft of its report was handed to the Secretary-General in September 1970. The report is the work of a number of individuals acting in their personal capacities and not as representatives of any Member government of OECD or the Secretary-General. Consequently, it will be understood that the views expressed in the Report remain the sole responsibility of the Group and that the recommendations are designed to call attention to a number of issues of public interest which merit careful consideration.

MEMBERS OF THE GROUP

M. Pierre PIGANIOL
Chairman

Dr. S. BALKE

Dr. L.M. BRANSCOMB

Professor S. HAMADA

Dr. H.T. HOOKWAY

Dr. B.V. TELL
Rapporteur

Dr. J.R. WHITEHEAD

SECRETARIAT

Dr. A. KING

Mr. P. MENKE-GLÜCKERT

Mr. P.J. JUDGE

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TRANSLATION OF A LETTER FROM THE CHAIRMAN OF THE AD HOC GROUP, MONSIEUR PIERRE PIGANIOL, TO THE SECRETARY-GENERAL

Dear Secretary-General,

At the beginning of last year you asked me to act as Chairman of the Ad Hoc Group which has been studying how OECD policy should be developed in the field of information. Before I give you our report, I should like to pay tribute to the efforts made in this field by the OECD since 1950, culminating in 1964 in the creation of the very successful Information Policy Group. These OECD efforts were warmly recognised by the Ministers of Science at their meeting in 1968, where they recommended that a " national focus " be set up in each Member country, at the highest governmental level, so that countries can be authoritatively represented in deliberations on this subject in the OECD context. The Organisation has also undertaken many other activities here of co-ordination or co-operation, of whose interest and effectiveness I have no need to remind you.

This meant that our Group did not find itself breaking entirely new ground, but it was able to consider a great deal of work which had already been done and which it could use as a basis for deciding future action.

I should like to make it clear that I did not really have to act as " Chairman " ; the small size of the Group and the high quality of its members meant that there was no need for a Chairman in the traditional sense : we worked as a team drawn together by what I believe to be a remarkable convergence of views. It seems as if, after our first, tentative exploration of the problem, we were all forced into agreement by the hard facts of the situation confronting us and it is this, I think, which gives the conclusions we have reached a particular significance and encourages me to suggest that our recommendations merit very careful consideration.

What are these hard facts ? Obviously the central one is economic growth. We now know that technical progress is not just a " residual " factor compared with the basic elements of capital and labour. In one industry I know well, while salaries have increased by 500 per cent, the prices of the products has only gone up by 50 per cent : this remarkable increase in productivity has been achieved to some extent by an increase in the scale of production (itself the product of a tremendous effort of technical research) but also by real mutations in the technology, which have only become possible through many and varied advances in scientific knowledge.

The problem of scientific and technical information seems to be closely linked with economic growth from two different points of view. On the one hand, the diffusion of information throughout the scientific and technical community facilitates effective progress in research and development ; on the other, information transfer offers industrial management the chance of taking optimal production decisions on a sound basis.

But we know that economic growth brings problems. It has to be mastered. Development should be coherent, and in consequence those responsible for macro-economic decisions require clear information not only on what is happening now, but on what is likely to happen later. Decisions can no longer be based only on present knowledge, but require also a clear vision of the technological future.

Finally, such decisions require public support, or at least a discussion of the issues involved between the government and well-informed representatives of the public. Viewed in this way, the information problem acquires new dimensions.

Each time a study is undertaken in some specialised field, a special language is used. It sometimes seems almost that the study takes on a life of its own : certainly there is often the impression that what goes on in that field is quite independent of the overall objectives to which it should contribute. But in fact the situation is generally not so serious : it is just that the jargon of the specialists hides the fact that the field really *is* integrated into its context. In the same way, although scientific information aimed primarily at research workers seems to develop quite independently of economic problems, this is just not true ; one can easily show that economic pre-occupations are present even in those parts of the information process that are most scientifically orientated. How-

ever, for the sake of efficiency, the information specialists need their own language, adapted to their own particular problems.

So it is not surprising that our report takes the viewpoint of the information specialists. But it should be pointed out that the Group has consistently tried to identify the way in which the " information system " articulates with the structures of economic growth and, more broadly still, with the nature of political decisions.

The effectiveness of human activities can only be assessed on the basis of a complete chain of events, which passes from scientific knowledge and its creation, through the stages of technical research and through many complex decisions, to the production of goods or services, integrated into an economic and political system. Exchange of knowledge is needed within each group of men concerned at each stage of this chain ; it may need translating into another " language " for transfer to other groups engaged in other tasks. The contribution of the Japanese member of our Group left us in no doubt that a major part of the Japanese success is due to the efficiency of their knowledge transfer mechanisms. It seemed therefore logical for the Group to concentrate not only on knowledge exchange among specialists but also on the assimilation of this knowledge by government and by other non-specialists, including the " man-in-the-street " (this assimilation can be seen as the transfer of knowledge to those who have not been involved in its creation). *Information* is the support for this transfer of knowledge. The ways in which knowledge becomes information, and conversely, need to be closely studied. Furthermore, economic growth is a human phenomenon and there is an obvious interaction between scientific and technical knowledge and the socio-economic structure. It is no longer possible to separate information and knowledge in the social sciences from those concerning the natural sciences. Lastly, such information should not build up a dead structure : the body of knowledge is in continuous evolution and it is vital, in order to forecast and influence the future, that information should contain at least the seeds of tomorrow's progress and discoveries. What distinguishes modern information from traditional documentation is precisely the introduction of this heuristic element.

These new concepts, and many other problems which have been long recognised, were the concern of the Group throughout its studies. We have tried to stay within the bounds of what is concrete and immediately necessary or immediately realisable ; we have nevertheless indicated a certain number of longer-term issues.

Let me summarise rapidly a few of our main points. The report consists of an Introduction ; an Analysis of current information practices and of the " classical " information problems (Chapter II) ; a statement of the general goals for a modern national policy (Chapter III) ; the implications of these goals for public policy (Chapter IV) ; and finally, a number of *Conclusions* which take up each of these themes, condensing them and providing an insight into the substance of the *Recommendations* that are linked to each conclusion. These Recommendations, addressed to the OECD, suggest a possible development of the Organisation's activities. But the Organisation should also be able to express the needs of its Member States, and contribute to the satisfaction of these needs through its analytical capabilities and through its co-ordinating machinery. Hence many of the recommendations of our report are also addressed to Member governments, defining the national policy structures which they will have to establish so that international co-operation can be effective.

I have no need to give a detailed analysis of these recommendations since they are very clearly set out in our Chapter V, but it may be helpful to bring out the main thread of our argument. The first recommendations concern the present activities of the OECD. Their high grade and relevance are generally recognised, but it will be necessary — and also sufficient — to develop these activities along the various lines indicated. The OECD is an excellent forum for comparing national policies, identifying options, suggesting priorities among the objectives. The OECD cannot consider information policy separately from research and development policy. The integration of these policies should be assured, which means that the systems should be broadened to include all the necessary relevant information. But it is not enough that the mechanisms of information transfer exist : it is necessary that they should function properly. In some cases this means that they should be completely restructured and the information they contain critically evaluated. In particular, governments cannot ignore the special nature of the information needed for industry and for other fields which are considered to be of national importance and which are sometimes called (a little ambiguously) " priorities ".

Information networks should be interconnectable, for the sake of economy and greater efficiency : this is a typical case where the Organisation is an ideal forum to study the possibilities of system interconnections. However, it goes without saying that information, in the broad sense, is transferred by people, whose education and

training for this task of information transfer also requires close attention.

Finally, smaller countries, particularly those which do not use one of the " world " languages, have special problems which the OECD studies should help to resolve, perhaps by facilitating access to international information networks.

The above is only the briefest summary of our unanimous report which I have the honour, Mr. Secretary-General, to transmit to you, thanking you for your interest and attention and assuring you of our sincere good wishes.

(*Signed*) Pierre PIGANIOL.

I

INTRODUCTION

Information the key to man's future...

The wise man does not act without attempting to know the consequences of his actions. Contemporary societies must be more prudent in their actions if technology is to be a boon rather than a curse for mankind. Information is the key to the wise management of our future.

Perhaps the most important event of the next decade will be the recognition of the true value of information — the right information, reliable and relevant to our needs, available in a useful form to all those who need it.

... society must learn to use it effectively.

The organized processing and exchange of information has reached a peak of sophistication in certain fields of professional specialization. The logical structure and basic language of science is designed to facilitate the organization and creative use of technical information. Great progress in this direction has also been made in the social sciences. Contemporary technology for information handling now permits more efficient storage, retrieval, and exchange of information between specialists. But the challenge of modern societies is the effective use of such specialized information to guide the destiny of those societies.

STI is only part of the information we need, a means to an end.

The information needs of managers and policy makers emerge as critical requirements, and their effective access to information from many disciplines and from many parts of the globe becomes imperative. Thus we must view scientific and technical information (STI) as only part of an immense complex of information including economic, social, legal and political aspects as well as technical ones. If national decisions are to be taken with regard to the many options facing decision-makers at top governmental level, with regard to sectoral policy or in industry, there must be provision on a full multidisciplinary basis of data which make it clear what are the probable consequences of these options.

Awareness in the OECD Member countries of the importance of scientific and technical research and develop-

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ment for sustained economic growth has encouraged Member countries both individually and jointly to promote the development of their scientific and technological resources. Science and technology have thus brought many benefits to mankind, extending life expectancy, dramatically reducing the need for man to serve as a beast of burden, and permitting the evolution of the social concept that poverty, ignorance and disease are not inevitable attributes of the human condition. Expectations have been raised everywhere.

But what end ? Society must decide.

But it is not only for the sake of economic growth and material prosperity that we promote and exploit science and technology. Serious concern and even open turmoil in many countries mirrors the failure of the industrialized world to exercise prudence in the uses of technology. The pollution of our environment is the most obvious side effect of policies which for many years have guided industry as well as social attitudes in the use of technology. Reconciliation of economic, social, and technical objectives and a need for the reduction of undesirable consequences calls for new understanding based upon better information.

The ability of society to use technology wisely is at stake.

Uncertainty surrounding the impact of technological change is rising dramatically and the nations find their ability to accommodate rapid changes severely limited. Thus the need for technical information goes far beyond the requirements of the scientists and engineers responsible for the successful exploitation of a new technical innovation. We must know not only the technological consequences but, more importantly, the social implications of this exploitation. Neither the information network nor the body of basic technical and social data are adequate to the task at this time. While planning, based on technical and social forecasts, is in its infancy, its importance requires that we view scientific and technical information networks in the light of this necessity.

Information policy is more than technology

... it is needed also **for** *policy.*

Impressed with the enormous volume and complexity of contemporary scientific and technical exchange, many see information policy as a complicated problem in documentation management, but fail to see it as a major component of policy for science and technology. But just as science policy must be an integral part of overall government policy, linked to social and economic affairs, information policy must seek to assure that the world's specialized and professional knowledge is fully and properly used in guiding social evolution.

While this perception of information systems as an element of government policy has not yet been widely re-

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cognized, there is an increasing international interest in the improvement of the information situation. OECD has exercised notable leadership in this respect, and UNESCO, the International Council of Scientific Unions, International Atomic Energy Agency, and other international organizations have made significant steps in this direction. Because of the universality of human knowledge, both in its origin and application, an international forum is not only appropriate but necessary for the evolution of information policy at the national level. Because of the leadership taken by OECD in the international discussion of economic and scientific policy, the OECD would seem a particularly appropriate organization through which to evolve the broader information policy proposed in this paper.

OECD can give important leadership

The need to view information policy in this broad context does not imply that any nation today possesses the capability to organize a satisfactory information network. The economical and effective use of automatic data processing equipment for information handling is still in its early stages. The quality and preparation for effective use of technical information is inadequate and serves as a major deterrent to the establishment of massive computerized systems. Few " management information systems " serving policy makers have yet proven superior to a small team of expert consultants equipped with telephone directories. But there are exceptions, and many exciting experiments are underway. The educational system, viewed as an information system, has only begun to take advantage of the power of contemporary information technology. While the needs of specialists — scientists, engineers, and economists — have been recognized by the establishment of a large number of sophisticated information networks, the needs of the other groups, such as skilled workers, local government officials, and private citizens have yet to be dealt with.

... the information revolution has only just begun.

These are policy for **STI**, *not propaganda !*

Finally, we must carefully distinguish between these professional information activities and the public information services of government, which, at their best, serve to inform the public of the government's activities and provide a medium for constructive political leadership, but at their worst constitute propaganda. While these public information activities of government are not completely separable from the concerns of information policy under discussion here (for example, in the release of monthly economic statistics) they must be clearly distinguished in the discussion of the bases for information policy and a locus of government responsibility for elements of that policy.

Strategies for policy...

... the challenge for OECD

This paper develops the context for information policy, elucidates its components and points out alternative strategies for implementation. The importance of the OECD in the exercise of leadership in this field is emphasized in the expectation that the overall economic and social goals of Member states and of the world community will be more readily achieved through the international development and harmonization of broadly based policy for scientific and technical information.

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II

CURRENT INFORMATION POLICIES AND PRACTICES

A. National and International Trends

An STI policy is a part of science and other national policies.

In the introduction we have advocated that policy for processing and disseminating scientific and technical information be considered an inseparable part of policy for science and technology, which in turn is an inseparable part of policy for achieving economic growth and other national goals. Most nations and international organizations have usually considered these policies to be separable and have considered only fragments of the total picture at any one time. In this section we will discuss briefly the existing situation and some recent developments.

Such STI policies are now starting to evolve.

Few countries of the world, if any, can be said to have a coherent, comprehensive information policy covering all related types of scientific, technological, economic, and sociological information. Certainly no OECD country has such a policy, although several are undoubtedly groping their way towards one now. This is entirely to be expected, since the relationships between the various types of information and their importance for economic and sociological development are far from understood.

Much coordination is needed.

All OECD countries operate extensive economic and sociological information gathering systems, and all make use of existing fragmented mechanisms for making scientific and technological information available all over the world. However, coordination between disciplines and coordination among nations, while still not very effective, is beginning to receive high level attention. (Indeed, the existence of our own group is one indication of this.)

In addition to information needs in the traditional sense, new possibilities are opened up by the use of TV, satellites, computer networks and other new technologies, and the systems and services developed to employ them. In few cases are these new technologies yet fully considered in national information policy, and there is therefore a

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particular need for devising interface methods for integrating the potentialities of technical developments in the communications field within comprehensive policies for information.

Ministers recommended a national STI policy « focus » ...

Recognizing the fragmented state of information systems, the Ministers of Science of the OECD countries recommended that each Member country establish a high level focus for information problems. They also reached an understanding that the OECD should endeavor to promote cooperation in establishing networks of comprehensive and compatible information systems. To enhance the ability of the OECD Member Nations to accomplish this objective, the Information Policy Group (IPG) had been established. This Information Policy Group has studied the development and management of national systems for the past three years, with the aim of providing a mechanism through which national systems can coalesce to become international. The " confrontations " of information activities in the Member states are an important part of the OECD preparation for international cooperation.

... with OECD as the international focus.

The OECD is not, of course, the only international organization active in the information field. Indeed, every type of mechanism for international cooperation — bilateral government-to-government agreements, intergovernmental international organizations, non-governmental international organizations, private international commercial enterprises — is now actively being used to promote international dissemination of information. For example, ICSU and UNESCO together have organized UNISIST, a feasibility study for the establishment of a world information system in science. The International Atomic Energy Agency has made considerable progress in establishing INIS, the International Nuclear Information System. The ICSU Abstracting Board and the International Federation of Documentation are endeavoring to develop major international programs. An international patent information system, ICIREPAT, is formally in existence and is rapidly becoming an important mechanism for exchange of patent information. The International Standards Organization, the World Meteorological Organization, the Food and Agricultural Organization, the International Labor Organization, and the World Health Organization all have extensive international information programs. The World Data Centers, established during the International Geophysical Year, comprise a worldwide information gathering and dissemination network.

Other international bodies also promote cooperation.

B. Users of Scientific and Technical Information

User groups include scientists, engineers, policy makers, politicians, and the public.

Scientific and technological information is used by many groups of people within society and for many different purposes. It is used by the scientific specialist as the basis upon which to build his own contributions. It is used by an engineer as an aid in the interpretation of data, in the design of new equipment, or to help solve a technological problem. Administrators and policy makers need technical information, organized and interpreted in a different fashion to be sure, to help make decisions within their responsibilities. Politicians need technical information to help them understand the political consequences of some technological decisions. And finally the non-technical citizen needs technical information, appropriately interpreted and applied, in order to understand the society he lives in and what it might become. In the sections below, we will examine each of these user communities in more detail.

C. Information for the Scientific Specialist

The scientist **creates** *and* **uses** *information.*

In any major field of science, significant information may be produced in any part of the world. Much new knowledge is passed on to others at scientific meetings or during visits to other laboratories. Much appears in the formal professional literature as specialized articles and books. In some countries technical reports comprise a substantial fraction of the total output. Any individual scientist has a major problem in attempting to learn what is already known, where it has appeared, and how he can get the source material. Numerous tools exist to help the individual scientist in this search. Abstracting and indexing journals cover most of the major scientific disciplines and technological missions. Perhaps the most comprehensive of these are published in the English language, which may create a problem for specialists whose native tongue is another language. Special new services taking advantage of the capabilities of modern computers are being developed to manipulate the data contained in Chemical Abstracts, Physics Abstracts, and similar publications.

But « information » does not always add to « knowledge »...

However, even after a scientist has located relevant information in the literature, a major problem still remains — that of knowing how good the information actually is. Much information in the literature has been superseded by newer information ; much is actually misleading or contains errors. Even when the user is a specialist in the field him-

self, he may have difficulty deciding whether the information is of high quality. In any case, he may not want to take the time and energy to evaluate the available information. Throughout the history of science, critical reviews and compilations have been produced to satisfy some of the needs for evaluation and condensation of information. Recently, numerous authorities have pointed out that a greatly increased output of compilations and reviews is needed in order to make efficient use of the world literature. Systematic evaluation is a quality control mechanism for all of science ; a critical review that points out sources of uncertainty and limitations in the experimental methodology, as well as uncertainties and errors in interpretation, may upgrade experimental practice throughout the world.

... evaluation review and analysis are needed...

The need for systematic review and evaluation has led to the appearance in many developed countries of " information analysis centers. " An " information analysis center " consists of a group of subject matter specialists, together with information processing specialists, who gather together the world output of information in a well-defined field, organize and store it for ready retrieval, and then systematically produce critical reviews, data compilations, correlations and codifications, and other intellectual contributions to new knowledge. The information analysis center concept is perhaps most advanced in the United States, but many other OECD nations operate information analysis centers although they may not be identified by that name.

... often in specialised « analysis centers ».

Systematic handling of information in the biological and social sciences is not as far advanced as it is in the physical sciences. Perhaps our reason for this situation is that these sciences have not been as well organized nor as well supported as the physical sciences. In addition, the primary literature in physical science is better structured and easier to evaluate than is the social science literature. An optimistic aspect of this situation is that the absence of the constraints of existing may make it possible to develop an information system that employs the best possible talents throughout the world and uses the most modern techniques.

Information services are lagging in the life sciences.

D. Technical Information for Industrial Engineers

Even though most countries support far more technological than scientific activities, their support of systematic handling of technological information for industry is not nearly so large as for handling of scientific information.

Industry needs information too,

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Effectiveness of the use of available information varies widely from one industry to another and even from one firm to another within the same industry. For example, the scientifically based electronics industry applies new information to its operations much more rapidly and more effectively than does the more traditional building construction industry. In addition, informal sources of information such as industrial sales literature and visits by technical representatives are as important as the more formal information systems.

not only for R and D, but also for design, production and marketing.

Industrial organizations require scientific information for their research laboratories, much the same as needed by academic laboratories. But in addition, manufacturers require design and product engineering information, for which conventional technical information systems are rarely appropriate. It is all too common experience that technologically obsolete designs are incorporated in recent editions of handbooks and then into production, with the result that technological progress fails to be reflected in common practice. New approaches are needed that take into account the special needs of these technicians and engineers.

Many reasons can be suggested for the less organized state of information systems for industry — the proprietary nature of such information, the cost of systems, habits of industrial managers, and the reluctance of competitive enterprise to share information.

E. Information for Policy Makers, Planners, and Management

Decision makers also need a variety of information...

More and more in contemporary society, information required for policy decisions has a substantial scientific and technological content. Indeed, resolution of a technical issue is often a prerequisite to provide the basis for dealing with a policy issue. The current concern for technology assessment as a guide for public policy in environmental management reflects this trend. The OECD studies of road research, national environmental policies, and other areas are increasingly showing the need for better access to a wider variety of information, not only on science and technology, but also on economics, urban problems, transportation, and other aspects of society. Planners and policy makers, whether in industry or government, usually have a professional background and are most aware of information sources available to their own professions. Relevant information from other areas of knowledge is

often not used simply because the persons who need it are not aware of its existence.

... which may be difficult to identify...

Perhaps the greatest obstacle, however, is that few problems are well enough understood so that decision makers can be confident that they even know what kind of information they need. This is especially true of major social problems ; the laws governing societal dynamics are only beginning to be worked out, and no one can now say with certainty that all of the facts needed in any given situation are known. A similar situation is true in industry also. The industrial decision maker must make his decisions on the basis of information selected from the entire environment in which his company finds itself — competition, taxes, technological development, the world economic situation — and combine this with internal information about his own company — financial situation, availability of manufacturing facilities, competence of the staff — and reach a decision. He knows in advance that he will never have full information on all of the factors that might influence his decision. A successful manager is one who reaches the right decision often enough to keep his operation profitable.

... and impossible to find.

« Management information systems » ...

Systems to provide this kind of information are generally called management information systems (MIS), and should be distinguished from the data banks and technical document retrieval systems usually meant by science and technology information systems (STIS). Their practical utility depends heavily on the success of the analytical processing of the facts contained in the system memory. Where the logical relationship between data and decisions is well established, and similar decisions and circumstances recur, a useful management information system may be readily achieved. The power of modern computer technology can permit both quicker and more rational decisions in such cases. In other circumstances where the manager or policy maker has difficulty defining his information requirements and the logic of his decisions is more subjective, the MIS may prove to be a very expensive demonstration of technology, but a poor aid to decisions. These systems hold great promise but require very careful development.

... already help... but need further development.

An additional problem is that much of the information that is available is couched in terms understandable primarily to the specialist in the field. In only a few cases are there systematic efforts to interpret and condense information to make it especially useful for problems other than the one for which it was originally collected. This is an area

where the systematic efforts of the information analysis center are beginning to be felt, but at present such centers are active in only a small fraction of the areas of human knowledge in which they might make a contribution.

F. Information for the Public

STI for the « man-in-the-street » ...

Scientific and technological information is interpreted and disseminated for the public by newspapers and magazines, by radio, and by television. In some countries the government issues numerous publications on a wide variety of subjects written for the public. Also, information directed specifically to the interests of the individual consumer is gathered and distributed by both governmental and private agencies in several countries.

... to understand the consequences of change.

The principal function served by providing information to the general public is the development of an electorate informed on the social and economic consequences of scientific and technological developments. Because so much of the material well-being of a society is based upon technological developments, and because so many modern problems are in turn a consequence of the use of technology, an informed and sophisticated electorate is essential. At best, it will not be easy for the public to maintain a balanced view and confidence in their government and in science in the face of conflicting claims about environmental hazards (the Pill, DDT, etc). Few countries, if any, can now claim that they have a sophisticated and informed electorate.

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III

GOALS FOR A NATIONAL POLICY ON SCIENTIFIC AND TECHNOLOGICAL INFORMATION

A. Need for Formulated Goals

STI systems have arisen largely unplanned...

The present information handling system that is found all over the world is the result of innumerable spontaneous responses to urgently felt needs. Guidance and planning, to the extent that there has been any, was provided in some cases by government agencies, in others by professional societies, and in others by private industry. Much has been the result of initiative by single individuals or by small groups.

... but policy guidelines are now needed.

Technical information of all kinds is now recognized as for too essential to the orderly development of society to allow its availability and quality to remain unguided by broad governmental policies for national and international development. National governments and international organizations must formulate sets of target goals to guide future actions. The need for policy for strictly scientific and technological information has been recognized as an element of science policy of most OECD Member countries. We advocate in this paper that policy guidelines be broadened to apply to social sciences such as economics, psychology, and urbanology.

To improve the means we must define the ends.

Target goals can be formulated in several layers of specificity, ranging in generality from the broad goals of an entire society down to the individual personal goals of a member of that society. In this chapter we are concerned with the broad goals of national government policy ; in Chapter IV of this report we shall discuss more specific goals of organizations within a nation.

There are four primary goals :

The sections immediately following are concerned with what we consider to be the four primary goals to be achieved by more effective scientific and technological information systems. These are :

1. to ensure the effective utilization of accumulated knowledge in science, technology, economics, and social sciences in order to achieve national objectives for the betterment of society,
2. to promote the development of science and technology,
3. to ensure the availability of adequate information for decisions for management and for policy both in government and in private enterprise, and
4. to focus the attention of governments and private organizations on the problems of information availability and use.

B. To Ensure the Effective Utilisation of Accumulated Knowledge in Science, Technology, Economics, and Social Sciences in Order to Achieve National Goals

To help **use** *science wisely.*

An increasing fraction of the goods produced by modern society is the result of the application of science and technology, subject to boundary conditions imposed by economics and social limitations. Accompanying this output, however, are unforeseen and increasingly harmful side effects, which probably can only be ameliorated by wise application of both new and existing technology. Wise application implies that more information must be available to decision makers and that this information must be integrated into systems that can be utilized by many groups within society. These systems must include information on economics, ecology, environmental quality, public health, education, and other aspects of modern life. Few people doubt that the further development of industrial society, both to produce more material goods and to improve the quality of everyday life, rests upon the further development and judicious application of science and technology. Our information systems must aid this application.

C. To Promote the Efficient and Successful Development of the Nation's Capability in Science and Technology

To strengthen science and technology.

Accepting as we do the premise just stated that the improvement of our way of life rests upon wise application of science and technology, it follows naturally that one of our basic goals must be the efficient and successful development of national capabilities in science and technology.

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Our information systems must contribute to the achievement of that goal.

Further, basic science has an important cultural and educational role in society. Nations take justifiable pride in the intellectual achievements of their citizens as evaluated by their peers throughout the world community. Distinguished scientists are a source of national pride, contributing to national self-confidence and dignity. Information systems must be, and generally are, accessible to the world-wide scientific community and responsive to its standards. They must be designed so that the information contained in their holdings is available to specialists in areas of science other than the field being covered and to applied scientists and engineers as well.

Information resources now used by technology are much more fragmented than those of science. Efficient and successful development of technology demands that all the types of information required be readily available. An engineer may need information on design specifications, measurement methodology, material properties, and computer programs in order to carry on his own project successfully. Attention must be given to the ways in which he gets such information and uses it, in order to determine what improvements, if any, in the present fragmented system are required.

D. To Ensure Adequate Information for Decisions for Management and for Policy both in and out of Government

To enable wise choices...

Information *about* science and technology and their consequences for policy makers is perhaps as important as information for scientists and engineers. Information systems designed for specialists usually do not provide material appropriate to the needs of policy makers and managers. For these needs, technical information must be interpreted in non-specialist language and then combined with economic and social and other kinds of data. In many large industrial organizations, effective systems using modern computer and communications technology to assemble technical, financial, marketing, and other information already exist, providing information on which management decisions can be based. Government decision making, usually on much more complex issues than any industrial firm has to deal with, is seldom able to rely on an effective information system at the present time. One goal for our national systems must be to provide the information required for the major decisions of society.

...by management and government.

E. Information to Focus the Attention of Governments and the Public to Priority Problems

A better understanding of change...

Some important information systems, such as statistics on GNP, levels of unemployment, and crime statistics serve the important function of directing public and political attention to new problems and changed circumstances. Such data are rarely sufficient by themselves to provide a basis for decision. They do serve to indicate the significant changes and to influence the priorities for national concern and allocation of resources. In fact the idea of priority is often misleading : priorities are often set as a *tactical* means of spreading out activities in time and optimising the use of available resources ; they are unfortunately often considered as *policy* and hence become, in this light, almost always very debatable. However, in smaller countries, priorities may correspond in fact to exclusive policy choices. Thus, one must distinguish between " choice-priorities " and the " tactical priorities. "

... brings problems of « priority ».

F. Information for an Informed Electorate

A national information policy must also foster a well informed electorate. Effective access to the STI base by the general public is a prerequisite to this objective. The educational process itself is a major vehicle for its accomplishment. And governments will wish to ensure that the public is well aware of the scientific and technical facts on which government policy is based. But the public must also have access to these same basic data in order to participate in informed debates on these policy issues, through which social goals and priorities are set.

Informed public debate on policy issues - an essential factor in democracy.

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IV

IMPLICATIONS FOR PUBLIC POLICY

A. Responsibilities of National Governments

What must government **do** *here ?*

We have just discussed the broad national goals toward which policies for information (and information systems) must be directed. Their achievement implies a governmental responsibility to carry on activities which themselves are directed toward the achievement of certain more specific objectives. And each of these objectives in turn demands the existence of activities with another more specific set of goals. In this report we have no need to trace this hierarchy of purposes in detail but we do wish to list a set of major objectives that national governments should set for themselves and strive to achieve. Some seem almost self-evident, and require no further discussion ; others are discussed briefly in later sections.

It should ensure... information availability,...

1. To ensure the availability of scientific, technological, economic, and social information adequate for national needs.

...accessibility...

2. To ensure that access to other national and international information sources can be obtained.

... in a social context...

3. To determine, if possible, the relationships between scientific and technological information and information about social phenomena.

...evaluated and analysed,...

4. To ensure that scientific, technological, economic, and social information is properly selected, digested, and analysed for educational, industrial, policy, and other public purposes.

...funds to study user needs...

5. To ensure that resources are available to study the habits and needs of information users, and to study new practices in information processing.

... and to satisfy them,...

6. To ensure that resources are available for the establishment and operation of appropriate information systems.

...effective management,

7. To ensure that the management responsible for central coordination has the breadth of view to

encompass the systems management skills, appreciation of user requirements, understanding the potential of library systems and the power of modern information technology, without being preoccupied with any one of these to the exclusion of the others.

...trained information staff.

8. To ensure that an adequate mix of properly trained subject specialists and information processing specialists is available.

B. Institutional Arrangements for Operation of Information Systems

A policy focus is needed in government...

Achievement of the specific goals mentioned above implies that certain institutional arrangements exist or be created. Among the Member nations of OECD, these institutions would be expected to vary considerably. In some countries, government institutions might assume most of the responsibility; in others private institutions might. Even if within government, different countries have chosen different means of organizing these responsibilities. In all countries, however, a high level governmental policy-making body is required. This policy body should be closely associated with that responsible for scientific and technological policy generally. This office may itself have a coordinating function only, or it may have operational responsibilities as well. The coordinating mechanism must have sufficient influence to ensure that needs of the governmental and private sector for scientific, technical, economic, and social information are adequately satisfied, and that excessive duplication among both governmental and private activities is avoided.

and the network must be **national** *in scope.*

Information activities of professional societies and private enterprise must be taken into account in the design of any system. The pattern of institutional relationships will depend upon the philosophy of government and traditional government-private patterns in each country. In most, if not all, countries the government will probably accept a responsibility to ensure that interconnection between various parts of the system is possible and that duplication is minimized.

C. International Interdependence

Knowledge is global...

No field of science or technology is limited in interest or applicability to one nation only. New information is

produced in most of the countries of the world which may be of importance to many others. To promote efficiency and economy, therefore, governments have a responsibility to ensure that all useful information relevant to national objectives is available. This is not to say that each nation should have an elaborate system of its own, nor that the government should necessarily take operational responsibility for providing information. Considerable reliance can be placed on regional or global systems, some of which may be operated by professional societies or even by private industry. The role that each government should play will depend upon traditional patterns of governmentai activity, upon the level of scientific and technological effort within the country, upon relationships of its technical community with those of other countries, upon the state of the national economy, and upon other factors.

...the nations must intercommunicate.

D. Special Manpower Development

Specialists must know subject matter as well as systems.

Effective operation of the various components of an information system requires that specialists of many kinds be available — specialists in the subject matter content of the system, documentalists, system designers, computer programmers, and others. In any system, the policy makers should be specialists in the subject content of the system. That is, chemists should set policy for chemical information systems ; meteorologists should determine policy for meteorological information systems. Once policy has been set, operations are carried out by those specialists who are most effective for the task being performed. However, all tasks that require judgment to be made on the value of information in a given field must be made by someone of adequate education and training. This is a principle that cannot be stressed too strongly. A person trained in documentation cannot evaluate chemical information, nor can a computer programmer evaluate oceanographic data (although his program may process such data).

New skills must be encouraged...

To the extent that a government takes responsibility for the education of its citizens and for the well-being of its society, that government should take adequate steps to ensure that an adequate mix of specialists of all kinds is available to operate information systems. Most governments are deeply involved in the development of curricula for fields of education. Few governments, however, make an effort to adjust the numbers of students that receive training in specific fields. Consideration should be given to methods by which this might be done.

together with a sound career structure.

An important social problem exists in the procurement of adequately trained manpower for information systems. Among professional specialists, " information " activity is regarded as a lower type of work. This attitude is changing, especially towards those professional specialists who work in information analysis centers, but is still a strong deterrent to professional participation. Government policy should endeavor to remove this inhibition by upgrading the recognition, status, and salaries of information system workers.

E. Need for User-Oriented Dynamic Information Systems

Systems should respond actively to their users.

Any effective information system must maintain close contact with its users. It must adjust its output to the needs of its users and it must learn whether its output is adequate to the user's requirements. Further, an effective information system should call to the attention of its users information that may be of special importance. That is, it should not be just a responsive system ; it should be an active system. For the information system we have been discussing in this report, its output must include special documents and services calling to the attention of both public and private officials needs for information as well as problems and deficiencies in the information system itself.

F. Need for Research and Development in Information Processing and Use

R and D is needed on how information is **used**...

A further implication of the goals stated in the earlier section is that research and development are needed on various aspects of the information transfer process. Not enough is known about how information is used for technological innovation. Not enough is known about the ways engineers receive and use information in their daily work. Not enough is known about the attitudes of users of information toward information available from unfamiliar sources. It is probable that characteristics of the information system, itself, may alter the reward practices and habits of research performers, in spite of the well known conservatism of the scientific community. Maximum encouragement for innovation and flexibility are required, to provide opportunities to develop systems that will be used effectively.

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... on how to handle it more effectively...

New technologies for storing, indexing, retrieving, and communicating information provide a multitude of alternatives to the traditional methods that have been in use. Computer based systems taking advantage of low-cost long-distance communications may provide opportunities for world-wide access to bodies of information located anywhere in the world.

... and on how to use R and D information better !

A great deal of research and experimentation is going on, under both government and private auspices. Much of the resulting information is not used ; indeed, most systems designers are unaware of the existence of much information of great value. Perhaps information system designers are a bit more adept at using stored information than other system designers but they cannot claim to set a shining example that all should follow. For example, probably nowhere in the world is there anything approaching a comprehensive bank of information on information research. In the interest of economy, governments have a responsibility to ensure that available information is used as effectively as possible.

Looking into the future, advanced research in information science may bring new discoveries of great value that can be seen only dimly today. Our promising avenue is research on the use of information systems in the creative process — a possibility that the process of discovery itself may be built into the information systems of tomorrow.

G. Implications for Future Development

Centralised systems or networks?...

We now consider two additional policy implications of the broad goals. These are :

1. whether the information systems should be centralized or be comprised of an interconnected net-work of relatively independent segments, and
2. the extent to which a nation should attempt to be self-sufficient rather than relying upon international interdependence.

... probably networks...

Although there are many advocates of highly centralized national systems that might evolve into a world system, no such centralized systems exist today, and we consider it unlikely that an effective one could be constructed. Most countries rely on a highly complex set of multiply-interconnected specialized systems. Centralized systems would have the advantages of providing large amounts of information of various types from a single source and of ease of

interconnection with other national systems. They would have the disadvantage of having to maintain enormous information banks and of having great investment in a system liable to rapid obsolescence. They may become rigid and difficult to adapt to new technology and to new or modified user needs. The information system of the future is probably a network in which queries inappropriate to one system can be shifted over to another, in which specialized user requirements can be met by special adaptations, and in which experimentation and innovation can go on in parallel.

... for economy, responsiveness and innovation.

An information industry of impressive proportions is developing around new technologies for information storage, retrieval, and communication. If the information industry in the private sector is to participate effectively in systems operations, flexibility in systems and networks must be permitted. Our belief in a decentralized flexible network would suggest that government policy emphasize performance criteria and standards and encourage innovation in design specifications.

Balance between national **in-** *and* **inter-** *dependence...*

Appraisal of the proper balance between internal self-sufficiency and international interdependence must be made by each country. No nation can be truly self-sufficient in scientific and technological information since such information is generated throughout the entire world and scientific truth is universal. In the social sciences and in politics, the information may be relevant only to local conditions and to national goals, and therefore of lesser applicability to other nations. This implies that a nation needs an internal system to enable it to take advantage of the entire world's technical output plus the ability to obtain and use information of strictly national importance.

... must be found in relation to special national needs.

National languages, institutional characteristics, and economic and social patterns may dictate a need for local adaptation of information systems. In addition legitimate needs for control of proprietary and national security data are found in each country. Nevertheless, the effect of sharing the world's basic scientific knowledge is so obviously in the self-interest of every nation that a high degree of international interdependence is not only to be accepted, but welcomed. Government policies must ensure that institutional arrangements for the flow of scientific, technological, economic, and social information are compatible with a spirit of mutual respect and friendly competition and cooperation.

V

CONCLUSIONS AND RECOMMENDATIONS

This study was started on the initiative of OECD, following discussions in the Third Ministerial Meeting on Science held in March 1968. In doing this, the OECD was demonstrating its concern, as an inter-governmental body, to analyse and where possible anticipate key policy issues affecting its Member countries. The conclusions that follow indicate some future activities for the Organization ; far more important, however, are the opportunities suggested for action by Member governments, either singly or in concert. The value of this report will be judged by the impact it has on new policy orientations in the countries and the unifying influence that the new thinking on all aspects of information transfer has on all aspects of goverment activity.

ON THE SCOPE OF ACTION OF THE OECD

CONCLUSION 1

The activities of the OECD in the scientific and technical information field, primarily conducted through the Information Policy Group (IPG) have been constructive and farsighted. Their activities have a very close relation to the work of the Committee on Science Policy (CSP). We conclude, however, that the scope of the IPG has been too narrow, for it has focused primarily on mechanisms and interfaces between components of the international network and has not given sufficient attention to the broader issues raised in this report. The initiatives already taken toward the close integration of the information programs of the IPG with the work of the Computer Utilization Group, and other OECD science activities in areas of public policy are encouraging and should be strengthened.

RECOMMENDATION 1

We recommend that the OECD organize and expand its information policy activities in such a way that :

a) the work of the IPG can be continued ;

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b) the scope of concern for information systems for policy be extended to include classes of information outside natural science ; and

c) the issues raised in this report can be investigated in the context of government policy, broadly conceived, and

d) coordination of related activities in other parts of the OECD science programs are facilitated.

We recognize that this may involve to some extent economic, industrial, and perhaps political considerations that go outside the current scope of the Science Committee and the Directorate for Scientific Affairs, but this is a prototype of the problem faced by governments themselves ; that is, the national foci for scientific and technical information, normally located in association with the central organ for science policy, must develop effective interfaces with the social science information needs and sources of other departments of government.

In action taken to implement this recommendation, the OECD activities should include, but not necessarily be limited to, the following :

a) maintaining a continuing awareness of national and international developments in technical, management and policy aspects of information systems,

b) providing a forum for discussion of the implications of such developments to the Member states and for discussion of possible multilateral action that might be called for under OECD auspices,

c) encouraging the integrated approach to information for policy decisions in which there is a need for assessment of scientific, technological, economic, and social factors,

d) continuing to study special aspects of information systems of importance to Member nations,

e) continuing to provide a forum for negotiations on interconnection and standardization of information systems,

f) endeavoring to bring visibility to, and interest in, problems of information systems at the ministerial level, and

g) broadening the scope of IPG to include economic and social information questions, as well as the strictly scientific and technological.

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ON THE USEFULNESS AND APPLICABILITY OF SCIENTIFIC AND TECHNOLOGICAL INFORMATION SYSTEMS

CONCLUSION 2

Science and technology have been a boon to mankind and are essential to his future, but mankind must not be blind to all their consequences. Prudence demands that available scientific and technical information be used more effectively and intelligently in making public policy, in applying technology, and in developing science itself. The rapid expansion of knowledge makes it increasingly difficult to share and use information effectively. Traditional methods are too slow and too expensive and do not provide the evaluation and selectivity required for effective use.

Enormous amounts of money are being spent on experimental schemes for remedying present deficiencies; modern data processing equipment and communications permit a revolution in means for handling enormous quantities and varieties of information on a timely basis. New professions are developing to provide new human skills to guide this process.

As sponsors of science research, instigators of technical applications, and formulators of public policy, governments have a responsibility to be aware of the new developments and to guide them in constructive directions.

RECOMMENDATION 2

We recommend that governments at the highest level accord priority attention not only to the development of policies for the generation of scientific and technical information, but also to the development of policy for the efficient and prudent use of such information in policy formulation, in the conduct of the affairs of government, and in R and D management. Policies for technical information are essential for the effective use of information in policy making. We further believe that governments will find most useful, in the implementation of this recommendation, the mechanism of the OECD which has already been found effective and which should be further developed in pursuance of this broadening role. The OECD forum provides an excellent international focus for fomulating national policy goals, for identifying the policy options facing Member governments, for framing criteria by which particular options can be selected and for reaching common ground on the strategies by which these goals may be achieved.

CONCLUSION 3

Proper handling of scientific and technical information must not be regarded as an administrative or mechanical

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matter, to be considered apart from (and often after) the design of R and D strategy. Systems for dealing with scientific and technical information have quite different requirements for the four spheres of activity in which information is used ; for the conduct of science itself (for which most current systems are designed), for the effective generation of technology and its application in industry, for decision making and policy formulation, and for the enligthenment of the general public through education and public information.

RECOMMENDATION 3

We recommend that policies and strategies for scientific and technical information should be developed as an integral part of the design of policy as a whole and R and D policy, in particular, in such manner that in each of the above areas of public concern provision is made in advance for the scientific and technical information system requirements. Thus, the focus for policy concern in scientific and technical information should be closely associated with the focus of responsibility for R and D policy itself. OECD studies on the functions and structure of the different national foci and on the ways in which the national resources in scientific and technical information are coordinated and managed are demonstrating both the inevitable national differences and the ways in which these differences can be resolved and harmonized to facilitate working together internationally. These studies should be deepened and extended in the light of the broader vision of the function of the national focus which has been developed in this report.

CONCLUSION 4

For effective use in formulation of public policy scientific and technical information must be used in conjunction with social, economic, and political information. The development of systems for dealing with some of these types of data — especially in demographic and economic fields — is relatively far advanced in many countries but in some other fields (such as behavioral sciences) systems are still primitive.

RECOMMENDATION 4

We regard the evolution of future management information systems for government as an important objective but one difficult to achieve. Such systems must not only be designed to encompass all the available forms of relevant information but must also be timely, structured, selective, and credible. Thus, scientific and technical information must be seen in a larger context, embracing not only natural sciences and technology but also social science information. OECD has made a start in looking at the

organization of information for social science and other information and how this organization can be improved. Further emphasis must be placed here, as being one of the critical areas for the effective development of our future society.

Because decision-making in government requires scientific and technical information to be seen in this broader context, and because almost all departments of government are dependent to a great extent on professionally specialized information, links must be developed between the national focus for scientific and technical information and most departments of government. An evolutionary development may be anticipated from R and D and economics-oriented information systems to those providing access to the broad body of organized knowledge.

CONCLUSION 5

Current information systems generated by research workers primarily for their own requirements are well established but most are quite inadequate for users in other disciplines and in technology, and are increasingly inadequate in their own disciplines.

RECOMMENDATION 5

We recommended that governments give greater support to mechanisms for ensuring effective interchange of information among scientists, giving explict recognition to the key importance of informal systems, of which international personal contact and oral communication are an increasingly vital part. We further recommend that governments devote more effort to experiments in improving information transfer between scientists, particularly between scientists of different disciplines, and between scientists and non-specialists. Various kinds of information analysis, consolidation, evaluation, and repackaging can be envisaged here, and the different kinds of specialized information centers and information analysis centers have a vital role to play in improving the value — to science and to technology — of the national investments in R and D. These activities will improve both the quality and the usefulness of information in the hands of those who need it. More experiments are needed on the close integration of information systems for research workers into the processes of creativity.

CONCLUSION 6

Little attention has been given by governments to the systematic information requirements of industrial technology. Fragmentary studies suggest that the information channels actually used in industrial development and production engineering are only indirectly related to the or-

ganized systems developed by scientists, and thus, give poor access to the body of scientific knowledge. Yet in most nations with large science budgets, public investments in science are substantially motivated by desire for ultimate practical use.

RECOMMENDATION 6

Governments must determine the actual patterns of technical information use in industry and examine the utility of government sponsored scientific and technological information systems in the light of these patterns as well as the efficacy of these patterns themselves. Needs, are economically attractive and are relevant to the retraining of engineers and skilled workers as well as for development and production. There is also a need for extensive studies of the relationships between science and technology and the economy of nations and the well-being of their citizens. In the absence of such knowledge, systems for distributing and using information will not necessarily produce the intended result. OECD has made a start in identifying the government responsibilities in information for industry : the outcome of the seminar held in March 1970 should be critically analysed, to ensure that worthwhile follow-up by the Organization or its Member countries is not overlooked.

CONCLUSION 7

Governments are increasingly faced with problem areas requiring organized research and action programs : urban development, transportation systems, environmental improvements, energy services, etc. It is difficult to attack such problems successfully with the static, vertical structures traditional to government, for, concerted multidisciplinary activity by both public and private researchers are required. Not only are scientific, technical, economic, and social factors involved, but the four functions of research, development, policy-making, and administration must go hand-in-hand. Thus, information systems may be required to serve the needs of these four types of functions.

RECOMMENDATION 7

We recommend the experimental development of special systems for a few priority problem areas, perhaps initially on a national level, to see if it is practical to serve in a unified system the needs or researchers, engineers, administrators, and policy makers in a single problem area. The development within OECD of experimental information systems of this kind in relation to water resource management and urban development should be supported and accelerated, so that the lessons that can be drawn from this work can be applied as soon as possible in other fields. This will require the active participation by Member governments in these pilot projects. It will also afford the

OECD with an opportunity to demonstrate the coherence of its programs in science policy, information systems, project management and computer utilization.

ON QUALITY CONTROL OF BOTH CONTENT AND PROCEDURES OF INFORMATION SYSTEMS

CONCLUSION 8

Contemporary systems can efficiently handle large volumes of information with great speed. Given the appropriate information systems, the desire of decision-makers to call up original data could now be met without the necessity of relying exclusively on experts at hand to gather, filter, and interpret the data. There is a need for greater emphasis on quality control of information to ensure that it is not misleading without extensive interpretation. The most valuable contribution that a well-designed information system for management can make is to increase the confidence of policy makers in the information they receive.

RECOMMENDATION 8

We recommend that government authorities re-examine their needs for professionally specialized information for management decisions, in order to ensure that they are aware of the possibilities inherent in new information technology, and at the same time sensitive to the difficulty of ensuring coverage, internal consistency, credibility, and utility of the information received. In the establishment of management information systems for government, we recommend that emphasis be placed on :

a) definition of information needs,
b) provision for feedback to information-generators on how information was used, and
c) precautions to avoid designing value systems immutably into the information system.

OECD studies of computer utilization in public administration have begun to examine some aspects of this problem ; these studies should be supported and should be specifically oriented towards contributing to government policy formulation in this area, and the harmonization *where appropriate* of the action that follows. In these studies the emphasis recommended above is particularly appropriate.

CONCLUSION 9

Existing systems are at an experimental level of development. While many are not yet very satisfactory, they show great diversity and have the potential for adapting themselves to the needs of users. But, although the technology employed permits rapid adaptivity, the systems

often lack feedback from user experience to guide proper adaptation.

RECOMMENDATION 9

We recommend that serious attention be given to obtaining feedback from user experience to guide the evolution of the information systems in the network, both now and in the future. The information system must bear the burden of responsibility for adaptation and not force this burden on the potential user. At the same time, however, the educational system must prepare potential users to take full advantage of the information resources available to them. OECD studies of the inter-relations between the training of information transfer specialists, the development of "friendly" information systems and user-education are already tackling some aspects of these problems and should be supported and further extended.

The future potential of information systems also depends on further advanced research in information science. Particular attention should be paid to the role of information systems in the creative process. The OECD is an appropriate forum for scientific discussions of such possibilities.

ON EDUCATION FOR INFORMATION SYSTEM NEEDS AND FOR SOCIAL NEEDS

CONCLUSION 10

The demands of modern information systems for human talent are creating new professions and skills for which organized training is not yet adequate. Although some nations have taken major progressive steps to establish curricula for training modern information specialists, much remains to be done to find the right combination of skills to fit the new institutional formats for information handling. Needs range from indexing, translating, and programming specialists to the most broadly trained scientific analysts of a high order of critical judgment. Qualified and motivated manpower is the single largest restraint on the evolution of successful information services in science and technology.

RECOMMENDATION 10

We recommend that manpower and education programs of government consider seriously the need for developing trained personnel to participate in the design and operation of the information systems envisioned in this report. Innovative, reliable, and service-oriented people will be required in increasing numbers. OECD and other international bodies are looking at these training problems, and attempting to quantify future needs of different kinds

of specialists in a way which will facilitate planning of the teaching resources to train them. There are, however, other obstacles to effective recruitment : salaries, working conditions and an outdated image of the librarian and documentalist. Concerted action by governments is needed to overcome these obstacles.

CONCLUSION 11

Educational systems of the past have depended on exposure of youth to the information contained in static, archival form as provided by librarians before the advent of modern information technology. The dynamics of growth and obsolescence of human knowledge requires a more continuous process of education utilizing information systems better adapted to changing values, knowledge structures, and human needs. Technology makes this possible. Education of youth will then be concerned with preparation for a lifetime of organized relevant learning. The information systems must be educable too, preparing the world's knowledge for ready assimilation.

RECOMMENDATION 11

We recommend that the re-evaluation of educational requirements of modern societies take full account of the need for information transfer systems better adapted to the continuing re-education of adults. Totally new institutional arrangements must be evolved, involving opportunities and motivation for education concurrent with daily activities. Research to foresee and prepare for these developments is urgently needed. This again calls for close attention of governments, which will find the OECD a useful mechanism for exchanging experiences.

ON INTERNATIONAL COOPERATION AND NEEDS OF SMALLER COUNTRIES

CONCLUSION 12

Human knowledge is ubiquitously valuable, and information in natural science and engineering is especially so. With increasing costs of generating technical information and increasing importance of prudent government action on the basis of it, we conclude that international cooperation to share such information is not merely a fortunate world tradition but a human necessity. National self-sufficiency in scientific and technical information is not, and never has been, a realistic policy alternative, even for the largest nations.

RECOMMENDATION 12

We recommend increasing reliance on and strengthening of international cooperation as a means for using the store of human knowledge more efficiently for the benefit

of mankind. The Development Centre of the OECD is already deeply concerned in the provision of information for economic development to non-Member developing countries. Direct operational services of this kind have a continuing value, but in addition, there is a need to concentrate on the development of policy and OECD can concentrate on the development of policy for optimum utilization of scientific and technical information in governments, the design of user-oriented systems to serve economic and other national objectives, and encouragement of international compatibility of national systems, effective in international coordination of basic science information, ICSU having a special competence at highest levels of sophistication, while UNESCO presents the opportunity to provide a forum for the mutual interests of all nations, especially those in earlier stages of industrial development. Specialized international agencies such as IAEA, WHO, WMO, and ITU can be effective in their fields of technological information.

CONCLUSION 13

Many nations, especially those not using one of the major world languages, have the opportunity of access to the world body of knowledge, but face special problems in achieving this access. Since their own research inevitably contributes in modest amount to the total world information, these nations must pay special attention to adaptation to local needs of the world literature. Perhaps the most expensive, but unavoidable, task is translation into the national language.

RECOMMENDATION 13

We recommend that nations design their own R and D policies to take account of the world knowledge to which they can obtain selective access by proper investments in information transfer systems. Selection and adaptation to local need may dictate not only substantial investments in translation and processing activities, but also R and D designed to equip local institutions to utilize effectively this body of knowledge. Special consideration should be given to the possibility of pooling resources of smaller countries to avoid the necessity of duplication of national systems. A sharing of experiences among the smaller OECD nations might shed light on problems and alternative strategies in this field, and this might be appropriately undertaken in a special working panel of the Information Policy Group.

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